REMARKS

Claims 11-15 are presently in the subject application.

Claim 10 has been cancelled without prejudice and claims 12-15 have been amended to more fully define and more adequately protect Applicants' invention. The amendments do not add new matter nor raise an additional issue and, accordingly, entry of these amendments is respectfully requested.

The present invention relates to a monostable ferroelectric active matrix display, containing a liquid crystal layer in the form of a monodomain with a defined direction of the normal z to the layer of the smC* phase, wherein the normal z to the layer and the preferential direction n of the nematic or cholesteric phase (N* phase) form an angle of more than 5°, (see the present amended claim 12).

The object underlying the present invention is to provide a ferroelectric active matrix liquid crystal display containing a ferroelectric liquid crystal mixture, where the liquid crystal mixture assumes a monostable position, but without thereby forming a streaky texture, is temperature stable and makes it possible to achieve a very high maximum transmission and also a very high contrast, (see page 5, second paragraph of the present specification).

The problem underlying the present invention is solved by employing a liquid crystal layer having the above-mentioned features in the monostable ferroelectric active matrix display.

Claims 10-15 are rejected under 35 U.S.C. § 112, second paragraph in the use of the term "unambiguous". Claim 10 has been cancelled and claim 12 has been amended to incorporate claim 10 thereinto without the use of the term "unambiguous".

The normal z to the layer of the smC* phase denotes the direction perpendicular to the layer plane of the smC* phase. Thus, the description does not relate to the molecular direction.

Furthermore, the preferential direction n of the nematic or cholesteric phase is defined. This is the direction in which the longest axis of the nematic molecules are pointing. Accordingly, amended claim 12 and claims 11 and 13-15 dependent therefrom are not subject to a rejection under 35 U.S.C. § 112, second paragraph, and allowance of these claims is respectfully requested.

The Examiner has objected to drawings under 37 CFR § 1.83(a). It is to be pointed out that the subject specification does not contain drawings. Accordingly, Applicant will treat this as a mistake and no further action appears to be warranted.

Claims 10-11 are rejected under 35 U.S.C. § 102(b) as anticipated by Nito, U.S. Patent No. 5,214,523 ("NITO"). Claim 10 has been cancelled without prejudice and has been incorporated by amendment into amended claim 12. Claim 12 and claim 11 (now dependent from claim 12) are not anticipated by NITO.

NITO (the Sony-mode) relates to a ferroelectric liquid crystal display device having a monostabilized state as an initial state and continuous gray-scale. In NITO, at column 1, lines 8 to 10 it is stated that the liquid crystal material has a chiral smectic C phase. In NITO, column 2, lines 18-26 it is stated that the projection component on the substrates of the axial direction of a cone delineated by the liquid crystal molecule of a liquid crystal material having the chiral smectic C phase and the projection component on the substrates of the axial direction of the liquid crystal molecule itself are set so as to be in the same direction as the processing direction for orientation of the substrates. This state is monostabilized as the initial state. The monostable state is also discussed in column 6, lines 58 to 63 of NITO.

The ferroelectric liquid crystal mixture is filled into an antiparallel cell. By applying an electrical field during the cooling of the mixture a monodomain is obtained. The molecules are

oriented along the rubbing direction of the substrates, (see column 6, lines 44 to 52 of NITO. The liquid crystal material employed shows a cholesteric phase. The molecules, however, are not parallel to the rubbing direction, and there is no angle formed between the layer normal z and the preferential direction n. Especially, this angle is not more than 5°. The difference between the so called "Sony-mode" disclosed in NITO and the liquid crystal layer employed in the active matrix display according to the present invention are discussed with regard to **the enclosed Exhibits A-D** which are affixed hereto.

In Sony-mode the angle between the N-phase director and the smectic layer normal is principally 0, whereas this angle in the liquid crystal layer according to the present invention is more than 5°. The monostable position in the Sony-mode is parallel to the layer normals (projection onto the glass plate of the substrate) whereas according to the present invention it has an angle of more than 5°. According to the Sony-mode the layer angle is identical with the tilt angle, whereas according to the present invention it is independent on the tilt angle. The behaviour of the optical transmission is symmetrical according to the Sony-mode, when the polarity is inverted. According to the present invention, the optical transmission is asymmetrical when the polarity is inversed. Thus, a maximum transmission $I = I_0 \times \sin^2 (4\theta)$ is resulting, whereas according to the Sony-mode the maximum transition is $I = I_0 \times \sin^2 (\theta)$. This is evident from the Exhibits A-D. According to the Sony-mode there are two bright states 1 and 2, corresponding to a symmetrical change of the angle between layer normal and rubbing direction. According to the present invention, however, only on bright state is present, since in the staring state between the layer normal and the rubbing direction there is an angle of more than 5°. In the Sony-mode two changes of the director configuration are possible, which lead to the same optical transmission. According to the present invention only one change of the director

configuration is possible which leads to an optical transmission twice as high. This is evident from the drawing "response to pulses".

Thus, there is a principle difference between the liquid crystal layer employed according to the present invention and the liquid crystal layer employed according to the Sony-mode. According to the present invention the two-fold tilt angle can be achieved, which leads to 100% transmission, based on parallel polarizers. Consequently, the brightness is doubled, (see the subject specification, page 7, second paragraph). According to the present invention there are not two orientation domains which ultimately result in the above mentioned disturbing streaky texture since there are two normals to the layer according to NITO.

The display thus obtained appears completely dark at a suitable angle of rotation between crossed polarizers. It appears bright when a drive voltage of just a few volts is applied, the brightness being continuously variable by way of the voltage and, at said duration, having virtually the brightness of two parallel polarization sheets (see the subject specification of page 7, third paragraph). An important feature of this display is that the angle between the preferential direction of the nematic (or cholesteric) phase and the normal to the layer (z-director) is ideally equal to the tilt angle of the smectic C-phase. This angle is at least 5°.

Thus, the Sony-mode describes a totally different liquid crystal system which shows a different switching behaviour and which does not show the advantages according to the present invention.

The liquid crystal displays according to the present invention are based on a totally new technology which is based on a specific relationship between the layer normal z and the preferential direction n of the nematic or cholesteric phase. In this manner a significantly improved active matrix display can be obtained.

Since there is no indication in NITO of the specific angle dependencies of the monostable ferroelectric active matrix display according to the present invention, NITO does not disclose the active matrix display as presently claimed. Accordingly, claims 11 and 12 are not anticipated under 35 U.S.C. § 102(b) by NITO and allowance of these claims is requested.

Claims 10-11 are rejected under 35 U.S.C. § 102(b) and anticipated by Kumar, U.S. Patent No. 5,530,566 ("KUMAR"). Claim 10 has been cancelled without prejudice and has been incorporated into amended claim 12. Amended claim 12 and amended claim 11 dependent therefrom are not anticipated by KUMAR.

KUMAR relates to polymer dispersed ferroelectric smectic liquid crystals formed by inducing a force during phase separation. In the abstract of KUMAR it is stated that the switching of the liquid crystal may be either monostable or multistable. In column 1, lines 10 to 17 of KUMAR it is stated that the ferroelectric smectic liquid crystal dispersed in a polymer matrix provides an electro-optic effect offering multistable optical states, fast switching times, high contrast and brightness as well as wide viewing angles. In column 3, lines 56 to 58 of KUMAR it is stated that bistable or multistable switching of the liquid crystal is possible. The same bistability or multistability is discussed in column 4, lines 50 to 52 of KUMAR. Additionally, monostable materials are mentioned in column 5, lines 30 to 38 of KUMAR.

The difference between the KUMAR liquid crystal layer and the liquid crystal layer according to the present invention are as discussed above for NITO and apply equally as well.

KUMAR describes that a monostable "normally transmitting" device is formed when the liquid crystal phase in the microdomains strongly anchors at the surfaces of the mocrodomains. Consequently, the liquid crystal will return spontaneously to the light transmissive as – formed state shown in figure 1A when the voltage difference across the transparent electrodes is

removed (see column 6, lines 30 to 41 of KUMAR). In column 7, lines 1 to 6 of KUMAR it is again stated that the device is monostable when the liquid crystal and polymer show strong anchoring at the surfaces of the microdomain.

The monostable device of KUMAR corresponds to the Sony-mode with the only difference being that when voltage is not applied the display is transmitting and not dark. The layer normal and the rubbing direction however are identical as it is shown in one of the enclosed Exhibits giving an illustration of P versus A. There are two dark states 1 and 2 on each side of the normal state. Thus, the layer normals can be changed to either direction by applying an electrical field. This is also evident from figure 1. Consequently, the device of KUMAR shows the same switching behaviour and brightness as the display of NITO (Sony-mode). The monostable position is parallel to the layer normal (projection on glass plate), the behaviour is symmetric to a polarity change and the angle between the N-phase director and the smectic layer normal is essentially 0. The display of KUMAR does not show the doubled brightness and the optical transmission behaviour in response to pulses as the monostable display according to the present invention which has a monodomain with an unambiguously defined direction of the normal z to the layer of the chiral smectic C phase.

In the diagram "director configuration" the difference in the switching behaviour is specifically illustrated. According to the of display of KUMAR and the Sony-mode (NITO) the switching occurs to the left or right hand side starting from the monostable position. According to the present invention only one switching behaviour is possible starting from the monostable position having the unambigously defined direction of the normal z.

Furthermore, KUMAR is mainly relating to multistable displays, (see column 1, lines 11 to 17, the abstract, column 4, lines 45 to 52, column 3, lines 56 to 59 of KUMAR).

According to KUMAR, the term "monostable" only describes a state into which the liquid crystals relax once the voltage is removed (see column 6, lines 29 to 41 of KUMAR). Thus, when the voltage difference across the transparent electrodes is removed, the liquid crystals spontaneously return to one position, i.e., the monostable position. This is in contrast to a bistable display in which the liquid crystals remain in the switched state when removing the voltage difference. Thus, in the bistable display the liquid crystals are switched between two stable states upon applying a voltage difference having opposite directions.

This definition of monostable is totally different from the definition according to the present invention as indicated above and when discussing the Sony-mode.

Consequently, KUMAR does not disclose or suggest the specific monostable ferroelectric active matrix display according to the present invention, in which the monodomain has a defined direction of the normal z and the given angle between the normal z to the layer and the preferential direction n of the nematic or cholesteric phase. Accordingly, the active matrix display as claimed is novel and inventive over KUMAR and allowance of claims 11 and 12 is requested.

Claims 12-15 are rejected under 35 U.S.C. § 103(a) as being obvious in view of NITO. The deficiencies of NITO, discussed above, are reiterated hereat. Applicant's invention as defined in amended claims 12-15 are not rendered obvious in view of NITO and allowance of these claims is respectfully requested.

Claims 12-15 are rejected under 35 U.S.C. § 103(a) as being obvious in view of KUMAR. The deficiencies of KUMAR, discussed above, are reiterated hereat. Applicant's invention as defined in amended claims 12-15 are not rendered obvious in view of KUMAR and allowance of these claims is respectfully requested.

Neither NITO nor KUMAR discloses or suggests the specific monostable ferroelectric matrix display according to the present invention having the monodomain with a defined direction of the normal z and the specific angle formed between the normal z to the layer and the preferential direction n of the nematic or cholesteric phase.

Neither of the two references discloses the ferroelectric active matrix display as presently claimed. None of the references contains a pointer in the direction of the specific liquid crystal layer employed according to the present invention and the advantages obtained therewith, and accordingly, neither NITO nor KUMAR nor a combination thereof renders the monostable ferroelectric active matrix display according to the present invention obvious.

The Examiner is hereby authorized to call the undersigned attorney on record "collect" on any matter connected with this application. The telephone number is 212-588-0800. In the absence of the undersigned attorney of record, the call will be accepted by any attorney empowered in this application.

Respectfully submitted,

FROMMER LAWRENCE HAUG LLP
Attorneys for Applicants

By Jerome Rosenstock

Jerome Rosenstock
Registration No. 25,456
745 Fifth Avenue
New York, New York 10151
(212) 588-0800

VERSION WITH MARKINGS TO SHOW THE CHANGES MADE IN THE CLAIMS:

IN THE CLAIMS:

Claim 10 has been cancelled without prejudice.

Claim 11 has been amended as follows:

11 (Amended) The active matrix display as claimed in claim [10] 12 wherein the angle between the normal z to the layer of the smC* phase and the preferential direction n of the nematic or cholesteric phase (N* phase) lies in a range of from 0.5 times to 1.0 times the smC* tilt angle.

Claim 12 has been amended as follows:

12 (Amended) A monostable ferrolectric active matrix display, containing a liquid crystal layer in the form of a monodomain with a defined direction of the normal z to the layer of the smC* phase, wherein the normal z to the layer and the preferential direction n of the nematic or cholesteric phase (N* phase) form an angle of more than 5° and [The active matrix display as claimed in claim 10] wherein the ferroelectric liquid crystal layer has a phase sequence of

$$1^*\text{-}N^*\text{-smC}^*$$

where there may be an smA* phase having a range of existence of at most 2°C between the N* phase and the smC* phase.

Claim 13 has been amended as follows:

13 (Amended) The active matrix display as claimed in claim [10] 12 wherein the spontaneous polarization of the ferroelectric liquid crystal phase is less the 15 nC/cm^2.

Claim 14 has been amended as follows:

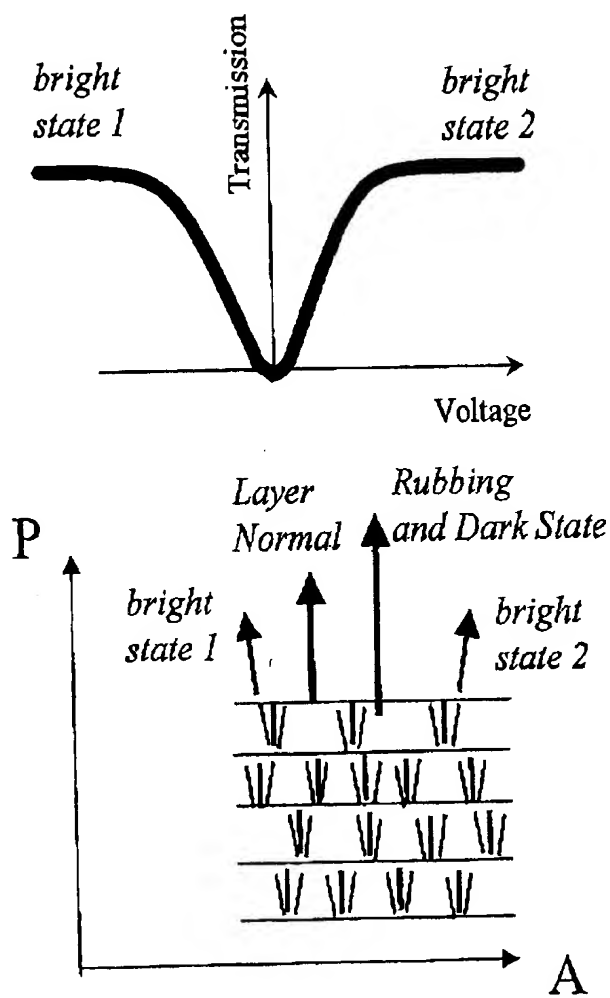
14 (Amended) The active matrix display as claimed in claim [10] 12 wherein, in the liquid crystal layer, the length of the chiral-nematic or cholesteric pitch in a temperature range of at least 2°C above the transition to the smectic phase is more than 50 μm.

Claim 15 has been amended as follows:

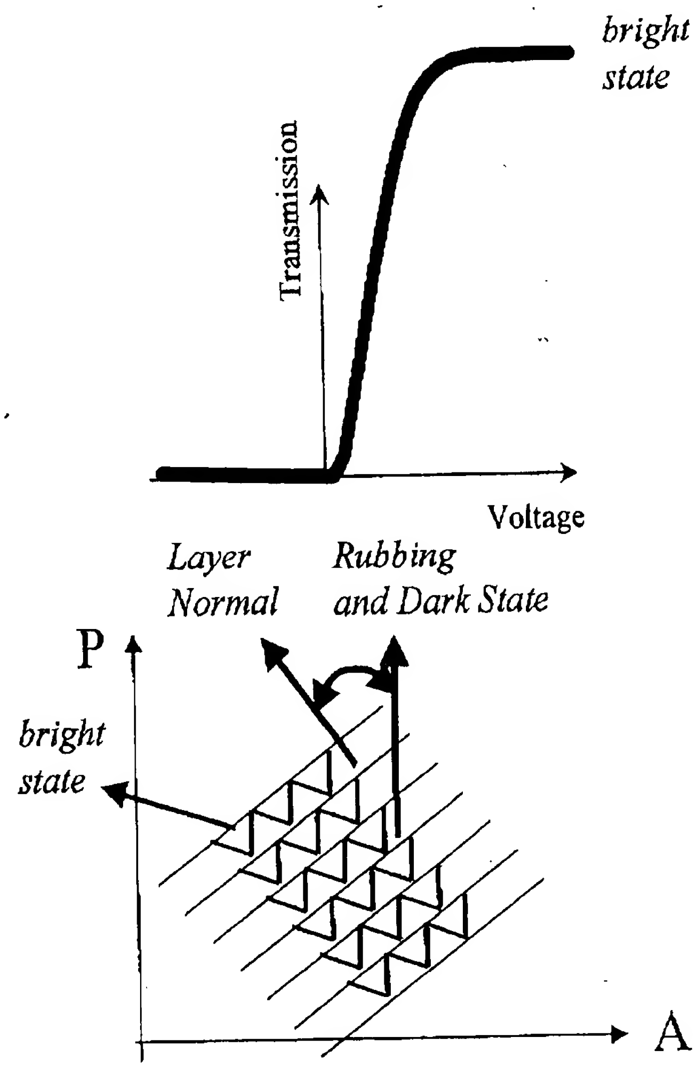
15 (Amended) A process for producing active matrix displays as claimed in claim [10] 12 in which the liquid crystal layer is introduced into the interspace between a rubbed upper substrate plate and a rubbed lower substrate plate of the active matrix display, the rubbing directions on the upper and lower substrate plates being essentially parallel, and the liquid crystal phase is cooled from the isotropic phase, an electric DC voltage being applied to the display at least during the N^* -> smC^* or N^* -> smA^* -> smC^* phase transition.

EXHIBIT A

Sony-Mode*



Present Invention



[*] Nito, K.

EXHIBIT B

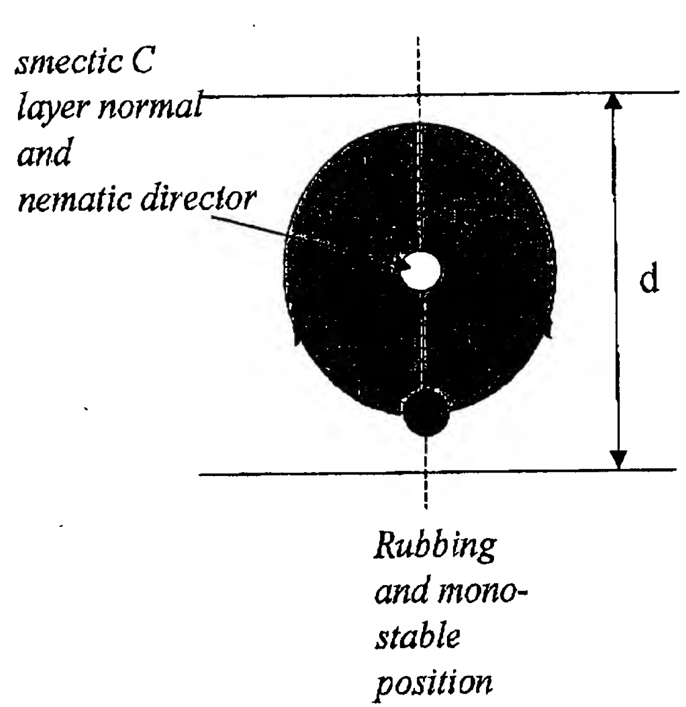
Sony-Mode*	Present Invention
1) Phase sequence: I N <u>A</u> C	Phase sequence: I N C
2) Maximum transmission: $I=I_0 * \sin^2 (2\Theta)$	Maximum transmission: $I=I_0 * \sin^2 (4\theta)$
3) Symmetric to polarity change	Asymmetric to polarity change
4) layer angle = tilt angle	independent on tilt angle
5) monostable position parallel to layer normal (projection on glass plate)	monostable position at ca. θ to layer normal (projection on glass plate)
6) angle between N-phase director and smectic layer normal is essentially Zero.	6) angle between N-phase director and smectic layer normal is approximately θ.

[*] Nito, K.,

EXHIBIT C

Director Configuration

Sony-Mode*



Present Invention

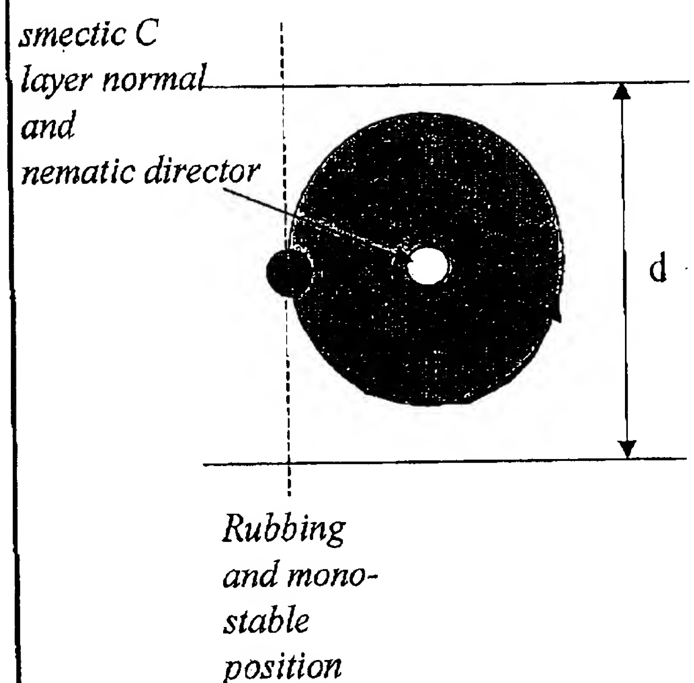


EXHIBIT D

Response to Pulses